Materials Science

DIELECTRIC PROPERTIES OF FERROELECTRIC THIN FILMS PREPARED BY METALORGANIC DECOMPOSITION METHOD

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Thin film preparation represents a large and growing field of materials science research. The Metalorganic Decomposition (MOD) method offers a simple and inexpensive means to prepare thin films using a mixture of metalorganic precursor solutions. The desired precursor mixture is placed drop-wise on to a desired substrate. The sample is then spun in a spin coater for a set time and speed. Next, the coating is pre-baked to a temperature (200 ^{o}C) sufficient to remove the organic solvent and further pyrolized at 550 ^{o}C to remove organic precursors and oxidize the metal. The process can be repeated to obtain a film of the required thickness. Finally the sample is annealed at higher temperatures (700-1000 ^{o}C) for further crystallization.

In the present work $Pb_{1-x}Sr_xTiO_3$ (x = 0 to 1) thin films of thickness ≈ 4μm were prepared on platinum substrates using the MOD method. Separate metalorganic precursor solutions of $PbTiO_3$ and $SrTiO_3$ were prepared using Ti (IV) 2-ethylhexoxide (liquid), Pb (II) neodecanoate, and Sr neodecanoate dissolved in xylene. $Pb_{1-x}Sr_xTiO_3$ thin films of desired x were prepared by mixing appropriate amount of $PbTiO_3$ and $SrTiO_3$ solutions. Room temperature x-ray diffraction results show that the films are polycrystalline with a perovskite tetragonal phase for $x < 0.6$ and cubic phase for $x > 0.6$. Thin film capacitors were fabricated by depositing Pt electrodes (1 mm diameter) on the oxide film. By measuring the low frequency (1 kHz) impedance, the capacitance and hence the dielectric constant was calculated at various temperatures from 25 – 300 ^{o}C. The films with $x < 0.6$ show a dielectric anomaly (broad) corresponding to ferroelectric to paraelectric phase transition. The phase transition temperature (T_c) decreases with increase of Sr content, as expected. However, T_c for thin films are lower than the corresponding values of bulk ceramic alloys.

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